

PAPER STRING RETICULATED STRUCTURE

BACKGROUND OF THE INVENTION

Technical Field

[0001] The present invention relates to a paper string reticulated structure formed by knitting paper strings composed of base wood pulp paper which is formed into a sheet by a wet paper machine, and in particular, relates to a paper string reticulated structure which is applied to a vegetation sheet efficiently used for transplantation, land formation, mountain surfaces, or revetment; an agricultural net efficiently used for birdproof nets, insectproof nets, weedproof nets, windbreak nets, shading nets, or animalproof nets; a construction net arranged on outer planes of temporary structures such as scaffolding at construction sites; or an article container such as a cloth basket, a vegetable storage basket, or a shopping bag.

Background Art

[0002] Conventionally, cords or strings made of natural fibers such as hemp or straw, or made of synthetic fiber such as polyethylene, nylon, or polyester, are used as a raw material for reticulated objects. In particular, natural fibers such as hemp or straw are combustible and easily decomposed in the soil, although the produced amount of raw material is low these days. In the case of synthetic fibers, harmful gas may be generated if it is burned, and it cannot be decomposed in the soil.

[0003] As a conventional vegetation reticulated body, metallic wire gauze is well known. Furthermore, a reticulated body in which the string objects comprising double layer water absorbing acrylic resin is used in at least a part of the warp and/or woof obtained by single or mix spinning of synthetic resin such as polyethylene, polypropylene, nylon, polyester, or acryl; cotton; hemp; palm resin; and animal fiber is disclosed in Japanese

Unexamined Patent Application Publication No. 21087/2002. However, metallic wire gauze is bulky when it is collected, and harmful gas may be generated when synthetic resin is burned. Furthermore, they are difficult to decomposed in the soil.

[0004] A vegetation sheet in which soft reinforcement consisting of a decomposition component and film forming component adheres on an upper surface of the sheet object knitted by decomposable fibers comprising plant material such as straw, hemp, or palm is suggested in Japanese Unexamined Patent Application Publication No. 153118/2002. However, the adhering process of the soft reinforcement is complicated and the cost is high. Furthermore, germinating and growing of plants may be impeded since the area of the opening part of the mesh is difficult to control. A vegetation reticulated body composed of a material in which antibacterial treatment is performed on a reticulated object comprising a plastic fiber such as nylon to be reformed into decomposable is disclosed in Japanese Unexamined Patent Application Publication No. 185062/94(Hei 6). However, harmful gas may be generated when it is burned since plastic fiber is used in the reticulated body, and it is difficult to decompose in the soil. Furthermore, water absorptivity and water retentivity which are required for vegetation is not sufficient.

[0005] There are many kinds of agricultural nets corresponding to the intended purposes. In recent years, insectproof nets are effectively used to prevent insects from damaging vegetables, particularly green vegetables, in cultivation using no agricultural chemicals or reduced amounts of agricultural chemicals.

[0006] Similar to the above-described vegetation net, a reticulated object composed of cords or strings of natural fiber or synthetic fiber is used in the conventional agricultural net. In particular, the natural fiber is

combustible and is easily decomposed in the soil, although the amount of the raw material produced is low recently. In the case of synthetic fiber, harmful gas may be generated if it is burned, and it cannot be decomposed in the soil.

[0007] In recent years, many kinds of biodegradable reticulated objects are suggested to solve these problems, although these suggestions have other problems. For example, a biodegradable net which is formed with lactone resin alone or with biodegradable resin comprising lactone resin and other biodegradable resin is disclosed in Japanese Unexamined Patent Application Publication No. 275987/99(Hei 11); however, it is expensive since the lactone resin, which is one type of special resin, is used. A composite paper which is prepared by mixing biodegradable thermoplastic synthetic short fibers and vegetable fibers for paper at specific ratios, or which is prepared by forming a biodegradable thermoplastic synthetic short fiber layer on one side of a layer not including biodegradable thermoplastic synthetic short fibers in Japanese Unexamined Patent Application Publication No. 32852/2000, although the biodegradable thermoplastic synthetic short fibers are expensive. An agricultural net in which warps and woofs are knitted and woven is disclosed in Japanese Unexamined Patent Application Publication No. 352844/2001. In this agricultural net, lattice mesh is formed with monofilament or tape yarn, and the warps and woofs are composed of polylactic acid containing starch as a raw material. An agricultural net in which warps and woofs are knitted and woven is disclosed in Japanese Unexamined Patent Application Publication No. 346456/2001. In this agricultural net, either the warps or woofs are formed into flat yarn to form a lattice mesh, and the warps and woofs are composed of polylactic acid containing starch as a raw material. These agricultural nets are hygroscopic and expensive since polylactic acid

containing starch as a raw material is used.

[0008] Disposable plastic bags are widely used at supermarkets or the like. However, in the case in which a customer prepares his/her own shopping bag, a service corresponding to saving of plastic bags can be given from the viewpoints of saving resources and reducing trash. As a cloth basket or the like, a basket formed with bamboo or natural creeper, or a basket formed into mesh structure using vinyl chloride resin or the like is widely used. As a method to store vegetables, a refrigerator can be used, although vegetables are stored in a plastic bag alone or stored in a plastic bag in a basket.

[0009] From these viewpoints, a basket or a bag having characteristics as follows is required in recent years: the appearance is stylish for shopping, storage of vegetables or cloths; it can be comfortably used; it can be folded if necessary; it is combustible when disposed; it can be naturally decomposed in the soil.

[0010] A shopping basket which can be carried easily, can be kept box-shape in the case of construction is disclosed in Japanese Unexamined Patent Application Publication No. 300913/2002, although the raw material is not identified in particular. A shopping bag which is light and compact to carry, and which can be carried on a person's back is disclosed in Japanese Unexamined Patent Application Publication No. 87415/2002. This shopping bag is formed with net yarn knitted with cotton or synthetic fiber.

[0011] As a cloth basket, a basket which is knitted with natural bamboo or creeper, a basket which is knitted with silk gut shaped string of vinyl resin or the like, and a basket in which gaps similar to mesh are formed by forming machine are well known. Alternatively, a basket in which plural baskets are combined is also suggested. However, a basket in which raw

material and structure of mesh are devised has not been disclosed yet.

[0012] In the case of the shopping bag mentioned above, of course a bag composed of natural fiber can be decomposed in the soil, but synthetic fiber is inevitably used to reduce the cost. Therefore, harmful gas may be generated if it is burned, or it cannot be decomposed if it is buried.

[0013] On the other hand, in the case of the cloth basket, the basket composed of bamboo or creeper is expensive, so a substitute of synthetic fiber, plastic gut, or bulk molded product is used in the present situation. These plastic products cannot be decomposed in the soil and harmful gas may be generated by burning.

[0014] Furthermore, material in which vinylchloride resin is coated on fiber fabric knitted with synthetic fiber such as polyester or polyamide fiber is often used in the conventional construction sheet. However, harmful gas such as dioxin may be generated if the sheet which is processed with vinyl chloride resin is burned. Furthermore, hydrochloric acid may be also generated, damaging incinerators. On the other hand, it is difficult to decompose if it is buried in the soil, and moreover, plasticizer contained in the resin may exude and contaminate the soil.

[0015] To solve such problems, biodegradable sheets are suggested in recent years. For example, a sheet which is arranged on outer planes of temporary structures at construction sites is disclosed in Japanese Unexamined Patent Application Publication No. 182052/99(Hei 11). In this sheet, the mesh part which accounts for most of the mesh sheet and a margin to sew up are composed of vegetable fibers, so dioxin is not generated if it is burned, and it can be decomposed by bacteria in the soil.

[0016] In Japanese Unexamined Patent Application Publication No. 80799/2000, a construction mesh sheet in which acrylic resin is coated on the surface of polyolefin mesh fabric is disclosed. This construction mesh

sheet is strong, and harmful gas is not generated if it is burned, and cold resistance and antifouling property are satisfactory. In Japanese Unexamined Patent Application Publication No. 303387/2001, a biodegradable construction sheet in which biodegradable polymer compound is added to one surface of polylactic acid fiber fabric is disclosed. In Japanese Unexamined Patent Application Publication No. 303388/2001, a biodegradable construction sheet composed of polylactic acid fiber fabric in which part of the polylactic acid fiber is fire resistant polylactic fiber is disclosed. In Japanese Unexamined Patent Application Publication No. 303391/2001, a construction sheet knitted with biodegradable polyester resin composed of two kinds of polyester resin whose difference in melting point is not less than 10°C is disclosed. In Japanese Unexamined Patent Application Publication No. 69293/2002, a flame retarder for a construction mesh sheet in which polyurethane resin water dispersion, non-halogen organic phosphate ester, and oxazoline group containing water based cross-linking agent are added. In Japanese Unexamined Patent Application Publication No. 275761/2002, a construction mesh sheet in which water-based acrylic denatured polyester base polyurethane resin is coated on a mesh sheet using synthetic fiber filament yarn is disclosed.

[0017] As is described above, the disclosed sheets are not biodegradable or are a combination of polylactic acid fiber fabric and biodegradable polymer compound. Alternatively, a part of polylactic acid fiber is processed to be fireproofing, or polyester fiber or the like is contained. Producing cost of these sheets is very high.

SUMMARY OF THE INVENTION

[0018] The present invention is completed in consideration of the

situation described above, and an object of the present invention is to provide a paper string reticulated structure having characteristics as follows: harmful gas is not generated if burned; sufficient assimilation in the soil is exhibited if buried; it is widely applicable to various uses by controlling thickness of paper strings or size of mesh; water absorptivity, water retentivity, and mechanical strength can be increased if necessary; and the cost is low.

[0019] The present invention is completed as a result of research to solve the problems described above.

[0020] A first aspect of the invention is a paper string reticulated structure comprising a paper string made from base paper containing soft wood kraft pulp as a main raw material. A second aspect of the invention is a paper string reticulated structure according to the first aspect, wherein the basic weight of the base paper is in a range from 20 to 80 g/m². A third aspect of the invention is a paper string reticulated structure according to the first or second aspect, wherein the base paper is prepared by a cylinder paper machine. A fourth aspect of the invention is a paper string reticulated structure according to one of the aspects of first to third, wherein the aspect ratio of tensile strength of the base paper measured by Japanese Industrial Standard P 8113 is in a range from 5 to 15. A fifth aspect of the invention is a paper string reticulated structure according to one of the aspects first to fourth, wherein the paper string reticulated structure comprises knotless net.

[0021] A sixth aspect of the invention is a paper string reticulated structure according to one of the aspects first to fifth, wherein the base paper contains wet paper strength enhancing agent. A seventh aspect of the invention is a paper string reticulated structure according to one of the aspects first to sixth, wherein the wet paper strength enhancing agent

comprises at least one kind selected from polyamide epichlorohydrin resin, epoxy based resin, melamine based resin, urea based resin, dialdehyde starch, polyacrylamide, or polyethyleneimine.

[0022] Furthermore, a eighth aspect of the invention is a paper string reticulated structure according to the first aspect, wherein the paper string reticulated structure is for a vegetation net. A ninth aspect of the invention is a paper string reticulated structure according to the first aspect, wherein the paper string reticulated structure is for an agricultural net. A tenth aspect of the invention is a paper string reticulated structure according to the first aspect, wherein the paper string reticulated structure is for an article container. A eleventh aspect of the invention is a paper string reticulated structure according to the first aspect, wherein the paper string reticulated structure is for a construction net.

[0023] Next, the present invention is explained further. A base paper used in the present invention contains soft wood kraft pulp as a main raw material. As the kraft pulp, ether bleached kraft pulp (NBKP) or unbleached kraft pulp (NUKP) can be used. Required tensile strength of the paper string of the present invention can be maintained by containing soft wood pulp at least not less than 70% of the entire raw material of pulp.

[0024] As another pulp which can be added to soft wood kraft pulp, there may be mentioned wood pulp such as hard wood pulp; non-wood pulp such as Manila hemp pulp, sisal pulp, flax pulp, or kenaf pulp; or waste paper pulp, as long as strength of the paper is not lost, can be added.

[0025] Beating process is performed on these pulps by a beater or the like to prepare raw material of base papers.

[0026] The degree of beating process is determined depending on the use the of paper string reticulated structure. In the case in which strong paper string is required, the beating process must be increased. In this case, the

strength of the paper string can be increased as the contained ratio of Manila hemp pulp is increased.

[0027] In addition, wet paper strength enhancing agent, kinds of filler, sizing agent, or yield improving agent can be added to the base paper of the present invention, if necessary.

[0028] In particular, wet paper strength enhancing agent is effective to prevent deterioration of strength (particularly by rain water) for a certain period. In this case, the kind of wet paper strength enhancing agent is not limited in particular, at least one kind selected from polyamide epichlorohydrin resin, epoxy based resin, melamine based resin, urea based resin, dialdehyde starch, polyacrylamide, or polyethyleneimine can be desirably used in the present invention.

[0029] As the sizing agent, internal sizing agent such as rosin based, alkylketene dimer, alkenyl succinic acid anhydride; or surface sizing agent such as kinds of synthetic polymer type can be used.

[0030] The yield improving agent is added to reduce loss of pulp and filler, to improve yield of paper. For example, organic polymer electrolyte such as polyacrylamide or inorganic salts such as aluminum sulfate can be applied to the base paper of the present invention.

[0031] To produce the base paper used in the present invention, the raw materials mentioned above are mixed to form a slurry of the paper material, and then the slurry is processed by a wet paper machine.

[0032] The wet paper machine for producing the base paper of the present invention is not particularly limited, and generally used paper machines such as a fourdrinier paper machine or a cylinder paper machine can be selected, although the cylinder paper machine is desirable to obtain tensile strength required for the paper string reticulated structure.

[0033] The basic weight of the base paper of the present invention is

desirably in a range from 20 to 80 g/m², and more desirably from 30 to 50 g/m². In the case in which the basic weight is less than 20 g/m², the paper may be easily torn when twisted, and in the case in which the basic weight is more than 80 g/m², the rigidity is increased and the paper becomes difficult to twist.

[0034] As a base paper of the present invention, a monolayer paper comprising 100% soft wood kraft pulp or comprising mixed paper of above-mentioned pulp components can be applied. Alternatively, a double or triple layer paper can be also applied. The aspect ratio of tensile strength of the base paper of the present invention in an ordinary state measured by Japanese Industrial Standard P 8113 is desirably in a range from 5 to 15. In the case in which the aspect ratio of tensile strength is less than 5, the paper may be broken when the paper is slit from paper roll into a tape-shape during paper string producing processing. On the other hand, in the case in which the aspect ratio of tensile strength is more than 15, the paper may be torn along the longitudinal direction when the paper is slit into a tape-shape.

[0035] The base paper obtained in the process described above is slit to have a tape-shape having dimensions of width 5 to 50 mm and length about 500 m, then the tape is twisted by a yarn twisting machine to produce paper string. The paper string of the present invention is desirably used one by one, although a string in which several strings are knitted or twisted can be used. Thickness of the string is not limited in particular, but it is desirable in a range from about 1 to 10 mm by the diameter from the viewpoint of handling.

[0036] To produce the paper string reticulated structure of the present invention, the paper string mentioned above is processed to be a knotted net or knotless net by using a net machine of ordinary net producing technique.

[0037] In the case in which the paper string reticulated structure of the present invention is applied to a vegetation net or an agricultural net, a knotless net is desirable. A knotless net is light and is not bulky since it has no knots and has plane connections. Therefore, workability of pasting paper in which seeds and fertilizer are attached is improved in the case of a vegetation net. Furthermore, appearance is good if the vegetation net is applied to a slope face since the mesh of the net is uniform. In the case of an agricultural net, especially when the net is used for nurture from sowing, paper or the like in which fertilizer is attached can be pasted, the workability is improved. In addition, the appearance of the agricultural net is also good. Furthermore, in the case of the vegetation net and agricultural net, assimilation by the soil is facilitated since the connection part of the knotless net is easily broken compared to that of the knotted net.

[0038] In the case in which the paper string reticulated structure of the present invention is supplied as a knot net, it is desirable that the paper string be lubricated by adding oil beforehand.

[0039] In the case in which the paper string reticulated structure of the present invention is applied to an article container such as shopping basket or shopping bag, a knotless net is desirable. A knotless net is light and is not bulky since it has no knots and has plane connections, and it is easy to carry. Shopping can be done without wasting disposable shopping bags. In addition, the shape of the shopping bag of the present invention can be changed depending on the amount of the article contained, and it is very useful. Furthermore, ordinary articles do not fall from the mesh of the bag if the mesh is sufficiently small. If necessary, a cloth can be spread on the inner surface of the bag to prevent small articles from falling through.

[0040] As a cloth basket or a vegetable basket for household use, a comparatively hard container which does not deform is required. To

obtain such an article container, the paper string of the present invention is strengthened, or thickened in the case of twisted state. Furthermore, paper strength enhancing agent or water soluble resin such as soluble starch or polyvinylalcohol can be added or coated on the paper string.

[0041] In the case in which the paper string reticulated structure of the present invention is applied to a construction net, the paper string is processed to be a knotted net or a knotless net by using a net machine using ordinary net producing techniques. As a mesh structure of the net, plain weave, twill weave, imitation gauze weave, leno weave, or leno-fabric weave can be performed. The mesh structure of the net is large, and porosity which indicates mesh opening is desirably in a range of from 10 to 60%, and the weight per square meter of the mesh sheet is desirably in a range of from 60 to 600 g/m².

[0042] In the present invention, harmful material is not generated if the paper string reticulated structure is burned since the raw material is wood pulp. Furthermore, if it is not burned, it is easily decomposed in the soil. Therefore, the paper string reticulated structure of the present invention is advantageous from the viewpoint of ecology and the environment. Furthermore, a reticulated structure having various size openings can be freely produced by controlling thickness of warp, woof, or oblique strings of the reticulated structure, physical strength, or knitted space. Flowing amounts of air (including windbreaks), light penetration rate, and humidity can be controlled depending on the porosity of the mesh.

[0043] In the case in which the paper string reticulated structure of the present invention is applied to a vegetation net, by adding wet paper strength enhancing agent to the base paper, water resistance can be maintained even if the vegetation net is exposed to rain water for a long time. At the same time, rain water is stably kept in the net owing to the

water absorptivity of wooden pulp used as a raw material of the base paper. Therefore, germinating and growing of plants can be promoted, and a slope face can be greened and strengthened.

[0044] In the case in which the paper string reticulated structure of the present invention is applied to an agricultural net, herbicide or repellents of insects and animals can be impregnated to meet such requirements. After the use of the agricultural net, the net can be buried with weeds and stumps of vegetable at the site. The net is decomposed in the soil after a certain period and harmful gas is not generated at all. To aid aging farmers, it is not necessary to carry or burn the net, and the present invention can supply an agricultural net which is superior in handling.

[0045] Similar to the net mentioned above, an article container such as soft shopping bag, hard shopping basket, cloth basket, or green vegetable basket can be made freely and easily by controlling the thickness of paper string, strength, and knitted space. Furthermore, coloring processes can also be performed easily since the raw material is wood pulp.

Commercial value can be increased by adding designs.

[0046] In the case in which the paper string reticulated structure of the present invention is applied to a construction net, similar to the net mentioned above, the present invention can provide a construction net having appropriate porosity for each purpose by controlling the thickness of the paper string and the knitted space. Also in this case, coloring can be performed easily. In addition, the construction net is strong, can be used repeatedly, and has a wide range of applications since the net is composed of special paper string as is shown in the Figures.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plane drawing showing a knotless net of the lead-through

type of the present invention.

Fig. 2 is a plane drawing showing a knotless net of the zigzag type of the present invention.

Fig. 3 is a plane drawing showing a knotless net of the hexagonal type of the present invention.

Fig. 4 is a plane drawing showing a knotless net comprising a Russell net of the present invention.

Fig. 5 is a plane drawing showing a knotless net comprising an ordinary gauze net of the present invention.

Fig. 6 is a plane drawing showing a knotless net comprising an improved gauze net of the present invention.

Fig. 7 is a plane drawing showing a knotless net comprising a fabric net of the present invention.

Fig. 8 is a partial perspective drawing showing an example of a shopping bag of the present invention.

Fig. 9 is a partial structure perspective drawing showing an example of a cloth basket of the present invention.

Fig. 10 is a perspective drawing showing an example of bent part.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0047] Examples of the knotless net which can be applied to the paper string reticulated structure of the present invention are shown in Figs. 1 to 7. That is, Fig. 1 shows a lead-through type having a structure in which each yarn of two net yarns are mutually crossed and extend straight passing through the joint part of the net yarn, Fig. 2 shows a zigzag type having a structure in which each yarn of two net yarns are mutually crossed 2 to 3 times and the net yarn extends in a zigzag shape, Fig. 3 shows a hexagonal type having structure in which each yarn of two net yarns are mutually

crossed 3 to 4 times and the net yarn extend straight via a joint part, Fig. 4 shows a Russell net having structure that is called "a lace net", Fig. 5 is a gauze net (ordinary gauze net) having a structure in which woof crosses through a space of twisted warps to form a net, Fig. 6 is a gauze net (improved gauze net) having a structure in which the woofs mentioned above are twisted to reduce sliding of mesh, and Fig. 7 is a fabric net having a structure in which yarns are simply crossed in fabric net. These are the embodiments of the present invention.

[0048] The present invention has broad applicability by controlling the thickness of the paper string and size of the mesh.

[0049] If necessary, the resin component can be coated or impregnated on the paper string reticulated structure to improve water resistance and physical strength. In this case, impregnation or addition of the resin component can be performed in a process before the reticulated structure is formed, that is, at the steps of the paper string or the base paper.

[0050] In the case in which the paper string reticulated structure mentioned above is used as a vegetation net, it may be used to fix a vegetation mat on a slope face by itself, soil dressing which contains seeds or fertilizer is blown on the paper string reticulated structure which is provided on a slope face, seeds or fertilizer is directly attached to the reticulated structure beforehand, or paper or the like in which seeds or fertilizer is attached is provided on the reticulated structure. Furthermore, by providing the paper string reticulated structure of the present invention on soil or on the surface of fields for agriculture or gardening, germinating and growing of seeds can be promoted since the paper string absorbs rain water and swells, and the rain water is stably held in the paper string.

[0051] The agricultural net of the present invention can be provided by covering over crops with half cylinders. After the crops are harvested, the

agricultural net is collected and buried in the soil of the predetermined place. In the case in which the net is used as a bird net at a fruit farm, the net can be expanded by props.

[0052] In the case in which agricultural net having herbicide impregnated beforehand is used, the net is provided at a part near the root of crops where weeds must be removed. In this case, herbicidal action is maintained as long as the structure of the agricultural net remains. After a certain term has passed, the net may be decomposed in the soil.

[0053] Furthermore, by controlling opening density of the net, atmosphere such as temperature, humidity, or light can be controlled. Therefore, the net can be applied as a gardening net by expanding over vegetables or flowers.

[0054] In the case of a shopping bag which is an example of the article container of the present invention, for example, a rectangle shape net which is formed from the reticulated structure shown in Figs. 1 to 7 is prepared as a body part 11, and as shown in Fig. 8, the lower edge of the rectangle is collected and joined by a natural fiber yarn such as a cotton to form the bottom part (collected part 13), opening part 14 in which an article is taken in and out is provided at the opposite upper edge of the rectangle by paper string or the like, and holding part 12 is composed of reticulated tape or cloth of natural fiber yarn shown in Figs. 1 to 7 by connecting with the opening part 14.

[0055] In the case in which rectangular shape basket (cloth basket or vegetable basket) is produced with the reticulated structure, as shown in Fig. 9, a rectangular reticulated structure shown in Figs. 1 to 7 is prepared as a body part 21, four edges are bent and raised to a certain height, to form bottom part 21a and side part 21b. If the flexibility of the mesh is not utilized, bending overlap parts 21c are required at four corners of the side

part. As shown in Fig. 10, the bending part is formed by the bending overlap part 21c formed at the side part 21b and the corner of 21b.

[0056] An edge 21d of the opening part is required for taking in and out, it is desirable that the edge be nicely formed by knitting or joining with paper string.

[0057] Although the case in which comparatively soft reticulated structure is used as a raw material is not shown in the Figures, when the side parts of the bottom part are raised, a structure having vertical wrinkles on the side part, that is, the structure in which stitches are thinly formed along the vertical direction and are wavy along cross direction can provide a basket having a soft texture.

[0058] In this case, when the side parts are bent, the opening part can be formed into a rectangle or circle as shown in Fig. 9, a wall in the longitudinal direction can be formed. In each case, the opening part may be bound with natural fiber or may be joined with a degradable resin. Combination junctions can be formed at the opening part by using paper string similar to the twisted string forming the reticulated structure. Furthermore, in the case in which an adhesive agent is used, cellulose-based, such as acetic cellulose, or starch-based is desirably used since they are easily decomposed in the soil.

[0059] The present invention can provide article containers such as shopping bags (including baskets) having good texture since the article container is composed of a reticulated structure formed by the paper string shown in Figs. 1 to 7.

[0060] By selecting the size of the mesh and adding tension along the vertical or cross direction, woven space is changed, and various kinds of production which is easy or difficult to deform can be obtained.

[0061] In the case of the shopping bag, small articles do not fall from the

mesh of the bag if the mesh is sufficiently small, and if necessary, a cloth or a small piece of paper can be spread on the inner surface of the bag to prevent small articles from falling through.

[0062] Furthermore, coloring process can also be performed easily to provide a shopping bag having a nice texture since the bag is a paper product.

[0063] Of course, in the case of the shopping bag, the article container of the present invention is useful as a cloth basket or vegetable basket, and it is compact since it can be folded when not used. Furthermore, coloring process can also be performed easily to provide patterns since it is a paper production. In addition, harmful gas is not generated if it is burned, and it is easily decayed in the soil after a certain term has passed.

[0064] The paper string reticulated structure of the present invention can be applied to a construction net. The construction net of the present invention includes a low dwelling net and a high dwelling net. In the present invention, a low dwelling net is a construction net arranged on an outer plane of a temporary structure such as scaffolding at a construction site of a low dwelling. This net prevents a person, trash, dust, or small articles for construction from falling or scattering from the scaffolding, and includes a scattering preventing net. A low dwelling is a building such as a wooden house or a light-weight steel house having a height of eaves of not more than 10 m. On the other hand, a high-rise building net is a net which is used for high-rise building of reinforcing steel or steel frame structure. The high-rise building net differs from the low dwelling net, but the purpose and the function of the high-rise building net is similar to that of the low dwelling net.

[0065] In particular, in the case in which flame proofing is required, red phosphorus based flame retarder, nitrogen based flame retarder, aluminum

hydroxide, magnesium hydroxide, silica, calcium hydroxide or the like is added at the paper producing process. Alternatively, they are impregnated after paper, string, or reticulated structure is formed.

[0066] The construction net of the present invention is used outside and exposed to sunlight for a long time, high weather resistance is required. Therefore, it is desirable that UV absorbent or light stabilizer, explained below, be added to the net.

[0067] To add the UV absorbent or the light stabilizer to the construction net of the present invention, these agents can be mixed with the pulp which is the raw material of the base paper, or they can be coated or impregnated on the surface of the base paper, or they can be impregnated to the twisted paper string or reticulated structure.

[0068] As the UV absorbent, cyanoacrylate based UV absorbent such as 2-ethylhexyl-2-cyano-3, 3'-diphenylacrylate, ethyl-2-cyano-3, 3'-diphenylacrylate, or octyl-2-cyano-3, 3'-diphenylacrylate, benzophenone based UV absorbent such as 2, 4-dihydroxybenzophenone, 2-hydroxy-4-methoxybenzophenone, or 2-hydroxy-4-octoxybenzophenone, benzotriazole based UV absorber such as 2-(2'-hydroxy-5'-methylphenyl)benzotriazole, or 2-(2'-hydroxy-5'-t-octylphenyl)benzotriazole, benzoate based UV absorbent such as resorcinolmonobenzoate, 2, 4-di-t-butylphenyl-3', 5'-di-t-butyl-4'-hydroxybenzoate can be used.

[0069] As the hindered amine light stabilizer, bis (2, 2, 6, 6-tetramethyl-4-piperidyl) sebacate, tetrakis (2, 2, 6, 6-tetramethyl-4-piperidyl) -1, 2, 3, 4-butanetetracarboxylate, bis (1, 2, 2, 6, 6-pentamethyl-4-piperidyl) · di (tridecyl)-1, 2, 3, 4-butanetetracarboxylate, or condensate of 1- (2-hydroxyethyl) -2, 2, 6, 6-tetramethyl-4-piperidinol and diethyl succinate can be used.

[0070] Furthermore, in the case in which sound proofing is required, particles having a specific gravity of not less than 3 comprising metal or a compound of the metal is added to the base paper or the paper string as a sound proofing agent. Sound which is generated at a construction site is generally of low frequency, and the sound disturbs the neighborhood. Therefore, a heavy net is desirable since the net can absorb the noise. As a metal or a compound of the metal having such a property, titanium, iron, copper, zinc, silver, barium, zirconium, manganese, antimony, tungsten or oxides of these metals can be used in the present invention.

[0071] The construction net obtained as described above can be easily decomposed in the soil. In the case of disposal, harmful gas is not generated even if it is burned.

[0072] In addition, the paper string reticulated structure of the present invention can also be applied to a wrapping material such as storage bag, a room interior material, a window blind, a desk lamp shade, a fishing net, or the like.

Examples

[0073] The present invention is further explained in detail by way of Examples..

Example 1

[0074] Domestic soft wood unbleached kraft pulp (NUKP) was beaten into 60° SR to prepare water slurry, and wet paper strength enhancing agent (trade name: polyfix301, produced by SHOWA HIGH POLYMER CO., LTD.) comprising polyamide epichlorohydrin resin was added into this water slurry, to account for 2% of the water slurry to prepare raw material for paper. The raw material was processed into a base paper having a basic weight of 30 g/m² by a cylinder paper machine.

[0075] Tensile strength of this obtained basic paper was measured by the method according to Japanese Industrial Standard P 8113, the tensile strength is 8.6 kg/15 mm for longitudinal direction, 1.6 kg/15 mm for cross direction, and the aspect ratio is 5.4.

[0076] Next, this base paper was slit into thin tape shapes having a width of 40 mm by bobbin winder, this tape was twisted 28 times/ 30 cm by a paper twisting machine to produce paper string having diameter of 3 mm. The strength of this paper string was 15 kg measured by Japanese Industrial Standard Z 1518.

[0077] This paper string was processed by a commercial net machine to produce a knotless net of the lead-through type shown in Fig. 1. On one surface of the paper string reticulated structure produced as described above, an ordinary vegetation based material, that is, a thin paper on which seeds, fertilizer, and soil improving agent were held by PVA adhesive, was attached to prepare a vegetation net. This vegetation net is provided on a slope face of a hillside which is formed by road works, and is fixed by anchor pins. As a result, roots of plants in the vegetation base material of the net extended and become fixed over several years, and the slope face will not be broken even if the ground was loosened artificially or naturally. Of course, the paper string reticulated structure of the present invention was homogenized with the soil in few years and further helped the growth of plants.

[0078] This paper string was processed by a commercial net machine, to produce a knotless net of the lead-through type shown in Fig. 1 having low opening ratio. Herbicide was impregnated into the obtained knotless net, and this net was provided to parts near the roots of crops where weeds were not desired. As a result, herbicidal effect was maintained as long as the structure of the net was maintained, and after a certain period, the

agricultural net was decomposed in the soil.

[0079] Similarly, a bag having an opening part on an upper part of the structure was formed by the paper string mentioned above, and a holding part was provided to the bag, and thus the shopping bag of the present invention could be produced as shown in Fig. 8.

[0080] Furthermore, the paper string mentioned above was processed in a commercial net machine, to produce a biodegradable construction net having a structure of an ordinary gauze net shown in Fig. 5. In this case, a narrow mesh structure can also be adopted.

Example 2

[0081] Except that water slurry was prepared by mixing 80 weight% of NUKP and 20 weight % of Manila hemp pulp and beating into 60° SR, base paper was prepared under the same conditions as in Example 1.

[0082] Tensile strength of this obtained basic paper was measured by the method according to Japanese Industrial Standard P 8113, the tensile strength was 11.8 kg/15 mm in the longitudinal direction, 2.1 kg/15 mm in the cross direction, and the aspect ratio was 5.6.

[0083] In the same conditions as in Example 1, the paper string and the paper string reticulated structure were produced by using this base paper, and a vegetation net was also produced in a manner similar to that of Example 1. This vegetation net was provided on a slope face of a hillside which is formed by road works, fixed by anchor pins. As a result, roots of plants in the vegetation base material of the net extended and became fixed over several years, and the slope face will not be broken even if the ground is loosened artificially or naturally. Of course, the paper string reticulated structure of the present invention was homogenized with the soil in few years and further aided the growth of plants.

[0084] An agricultural net comprising the paper string reticulated

structure of the present invention was produced using the base paper mentioned above in the same conditions as in Example 1. The obtained agricultural net covered fields of Chinese cabbage to form half cylinders and was fixed by anchor pins. As a result, the Chinese cabbage grew and was harvested without being eaten by harmful insects. After harvesting the Chinese cabbage, the net was disposed of at a certain place, and after a certain period, the agricultural net was decomposed in the soil.

[0085] Similarly, the base paper was processed to form the paper string and the paper string reticulated structure in the same conditions as in Example 1, and a shopping bag could be produced under the same conditions as in Example 1.

[0086] Furthermore, the paper string obtained under the same conditions as in Example 1 using the base paper mentioned above was processed to a commercial fabric machine, to produce a biodegradable construction net having a reticulated structure of a knotless net comprising the fabric net shown in Fig. 7. In this case, a narrow mesh structure can also be adopted.

Example 3

[0087] Domestic soft wood unbleached kraft pulp (NUKP) was beaten into 50° SR to prepare water slurry, and wet paper strength enhancing agent (trade name: polyfix301, produced by SHOWA HIGH POLYMER CO., LTD.) comprising polyamide epichlorohydrin resin was added into this water slurry, to account for 2.5% of the water slurry to prepare a raw material for paper. The raw material was processed to a base paper having a basic weight of 41.5 g/m² by a cylinder paper machine.

[0088] Tensile strength of this obtained basic paper was measured by the method according to Japanese Industrial Standard P 8113, the tensile strength was 13.1 kg/15 mm in the longitudinal direction, 1.9 kg/15 mm in

the cross direction, and the aspect ratio was 6.8.

[0089] In the same conditions as in Example 1, the paper string and the paper string reticulated structure were produced by using this base paper, and a vegetation net was also produced in a manner similar to that of Example 1.

[0090] This vegetation net was provided on a slope face of a hillside which was formed by road works, fixed by anchor pins. As a result, roots of plants in the vegetation base material of the net extended and become fixed over several years, and the slope face will not be broken even if the ground is loosened artificially or naturally. Of course, the paper string reticulated structure of the present invention was homogenized with the soil in few years and further aided the growth of plants.

[0091] The paper string was made by the base paper mentioned above under the same conditions as in Example 1, and an agricultural net having higher opening ratio than Example 1 was produced by the paper string. The obtained agricultural net was expanded on the ceiling surface of a cultivation house of flowering plants, and appropriate heat retaining property, high permeability, and insectproofing property were exhibited and the flowering plants grew well. After harvesting the flowering plants, the agricultural net was disposed of and decomposed in the soil.

[0092] Similarly, the base paper was processed to form the paper string and the paper string reticulated structure in the same conditions as in Example 1, and a cloth basket shown in Fig. 9 could be produced.

[0093] Furthermore, the paper string obtained under the same conditions as in Example 1 using the base paper mentioned above was processed to produce a biodegradable construction net having a structure shown in Fig. 1. In this case, spaces of mesh can be freely selected depending on use.

Example 4

[0094] Domestic soft wood unbleached kraft pulp (NUKP) was beaten into 50° SR to prepare a water slurry, and wet paper strength enhancing agent (trade name: polyfix301, produced by SHOWA HIGH POLYMER CO., LTD.) comprising polyamide epichlorohydrin resin was added into this water slurry, to account for 2.5% of the water slurry to prepare raw material for paper. The raw material was processed to a base paper having a basic weight of 42 g/m² by a cylinder paper machine.

[0095] Tensile strength of this obtained basic paper was measured by the method according to Japanese Industrial Standard P 8113, the tensile strength was 13.1 kg/15 mm in the longitudinal direction, 1.9 kg/15 mm in the cross direction, and the aspect ratio was 6.8.

[0096] The paper string was made by the base paper mentioned above in the same conditions as in Example 1, and an agricultural net having lower opening ratio than Example 1 was produced by the paper string. The obtained agricultural net is covered over the field of komatsuna (a kind of green vegetable) to form a half cylinder and, the net was used as an insectproof net.

[0097] 17 days after setting of the insectproof net, the komatsuna was harvested and the weight and presence of harmful insects were measured. Sufficient insectproofing effect was confirmed and the komatsuna grew properly. After using the insectproof net, the net was disposed of and decomposed in the soil.

Comparative Example 1

[0098] Mixed pulp in which 60 weight% of foreign hard wood unbleached kraft pulp (LUKP) and 40 weight% of domestic soft wood unbleached kraft pulp (NUKP) were mixed is beaten into 55° SR to prepare a water slurry, and wet paper strength enhancing agent (trade name: polyfix301, produced by SHOWA HIGH POLYMER CO., LTD.)

comprising polyamide epichlorohydrin resin was added into this water slurry, to account for 2% of the water slurry to prepare raw material for paper. The raw material was processed to a base paper having basic weight of 26.9 g/m² by a fourdrinier paper machine.

[0099] Tensile strength of this obtained basic paper was measured by the method according to Japanese Industrial Standard P 8113, the tensile strength was 5.1 kg/15 mm in the longitudinal direction, 1.7 kg/15 mm in the cross direction, and the aspect ratio was 3.0.

[0100] Next, this base paper was slit into thin tapes having a width of 40 mm by a bobbin winder, this tape is twisted 28 times/ 30 cm by a paper twisting machine to produce a paper string having a diameter of 3 mm. However, the paper was often torn, and it was difficult to form paper string. Furthermore, it was also difficult to form a vegetation net, agricultural net, biodegradable construction net, and types of article container.

[0101] The construction net of the present invention obtained in Examples 1 to 3 and the net of Comparative Example 1 were used as low dwelling nets practically. In the case of the nets of Examples 1 to 3, no net broke during the entire construction period and sufficient strength was confirmed. However, in the case of the net of Comparative Example 1 in which soft wood pulp was not contained as a main component, the net was broken merely by the falling of a piece of wood. Furthermore, the nets of Examples 1 to 3 were buried after use and were monitored. After several years, the structure of these nets were not maintained any longer and they were dispersed in the soil.

Comparative Example 2

[0102] A net which was produced by single vinylon spun yarn of yarn number count No. 20 (trade name: #CREMONA 300, produced by KURARAY CO., LTD.) was prepared, and the net was used to cover a field

of komatsuna to form a half cylinder in the same conditions as in Example 4 for use as an insectproof net.

[0103] As a result, similar insectproofing effect was exhibited as in Example 4, although the net could not be decomposed in the soil, and the net remained in the field.